

# **Satellite Sea-surface Salinity: Data and Product Biases and Differences**

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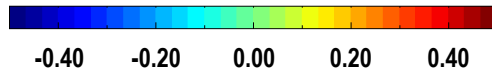
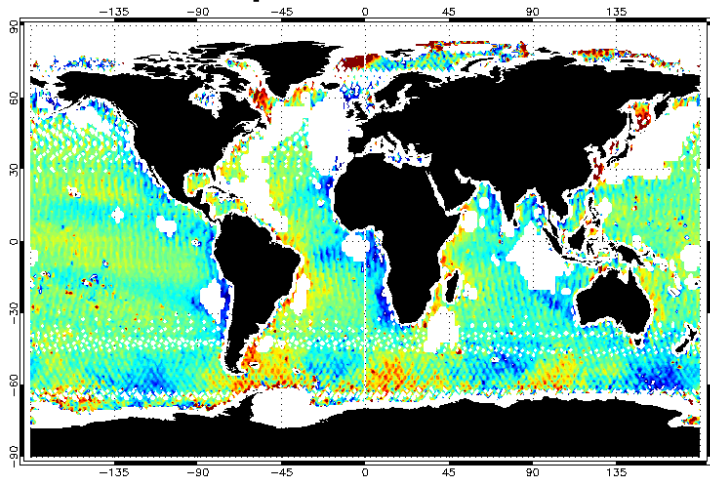
# Data

- Aquarius Data Processing System (ADPS) Level-2 SSS Version 3.0 without SST correction  
(Sep 2011 – Aug 2014)
- Aquarius Combined Active-Passive (CAP) Level-2 SSS Version 3.0 without precipitation correction  
(Sep 2011 – Aug 2014)
- SMOS Version 2.0 Level-2  
(Jan 2012 – Dec 2013)
- SMOS Version 2.0 BEC Level-3 monthly optimally-interpolated (OI) SSS  
(Sep 2011 – Oct 2013)
- Argo salinity profiles - ungridded (USGODAE Monterey Server)  
(Sep 2011 – Aug 2014)
- *Monthly sea-surface temperature* – NOAA Reynolds Optimum Interpolation (OI) V2  
 $1^\circ \times 1^\circ$  resolution
- *Monthly precipitation* – Global Precipitation Climatology Project  
 $2.5^\circ \times 2.5^\circ$  resolution
- *Monthly wind speed* – European Centre for Medium-range Weather Forecast Interim Reanalysis  
 $1.5^\circ \times 1.5^\circ$  resolution

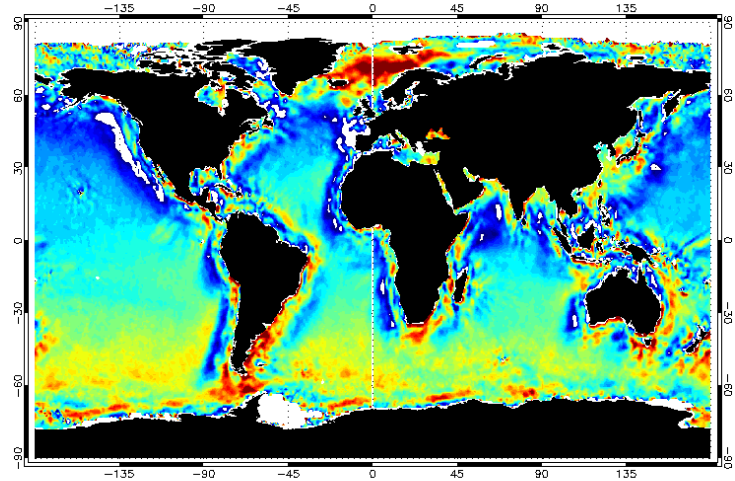
# Ascending – Descending Differences: Spatial

3-Year Mean  
Difference  
(pss)

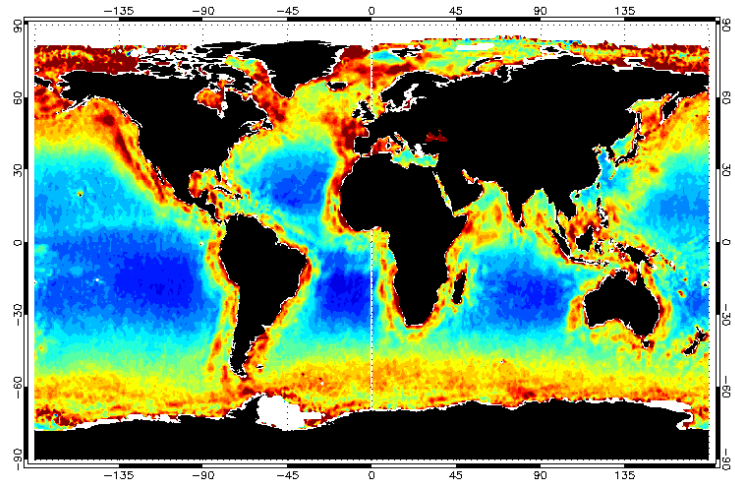
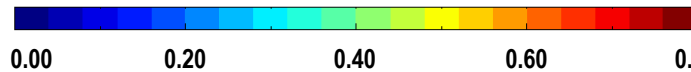
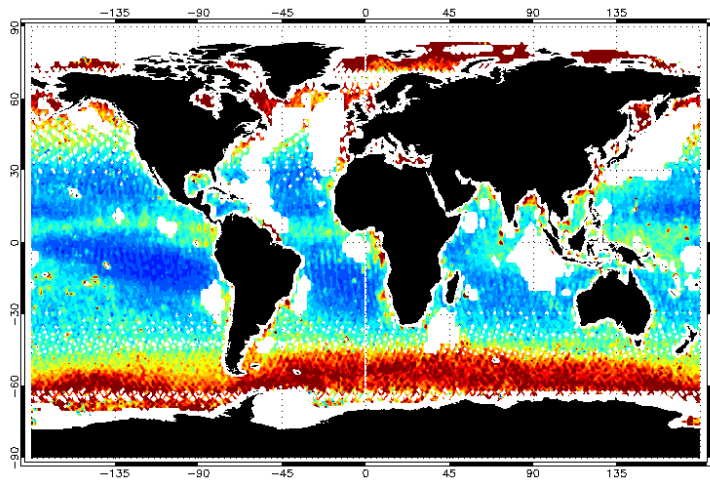
### Aquarius - ADPS



### SMOS

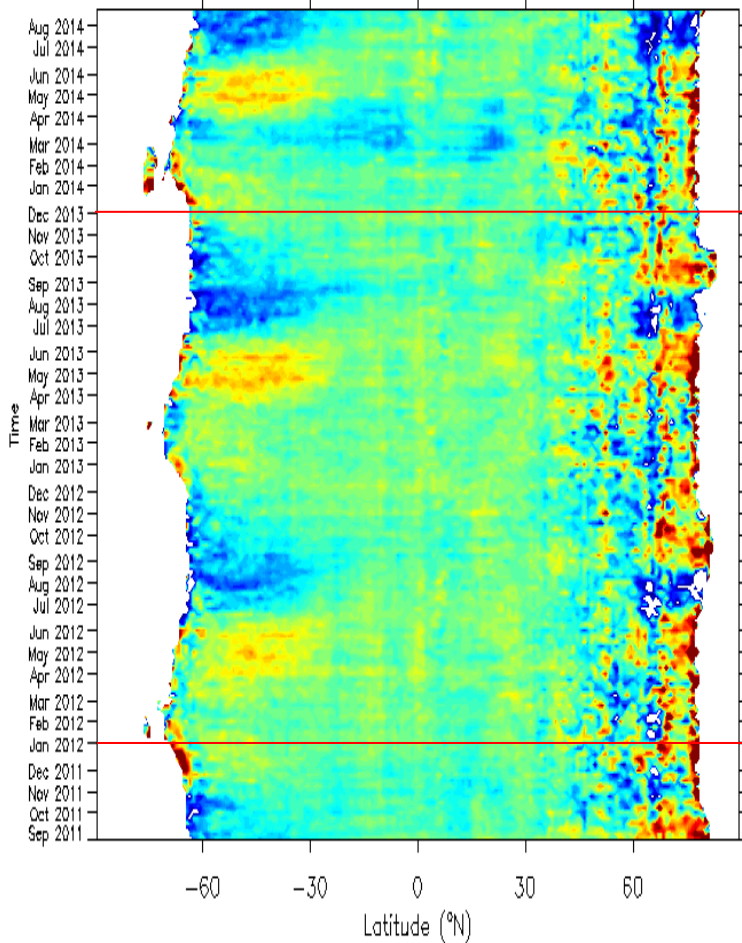


3-Year RMS  
Difference  
(pss)

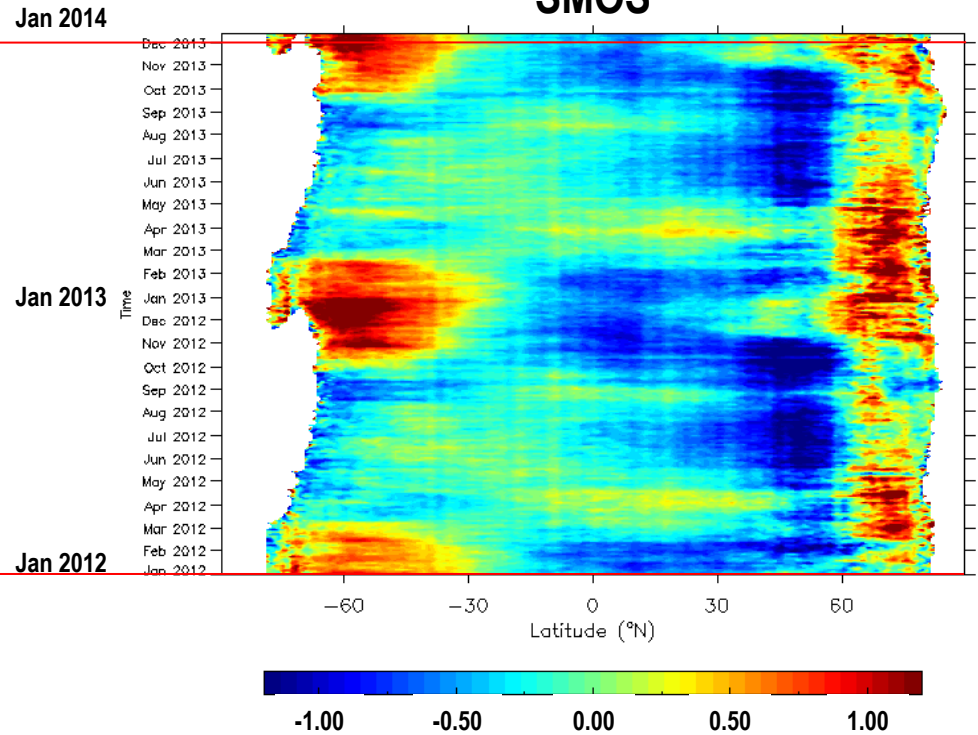


# Ascending – Descending Differences: Temporal

## Aquarius - ADPS

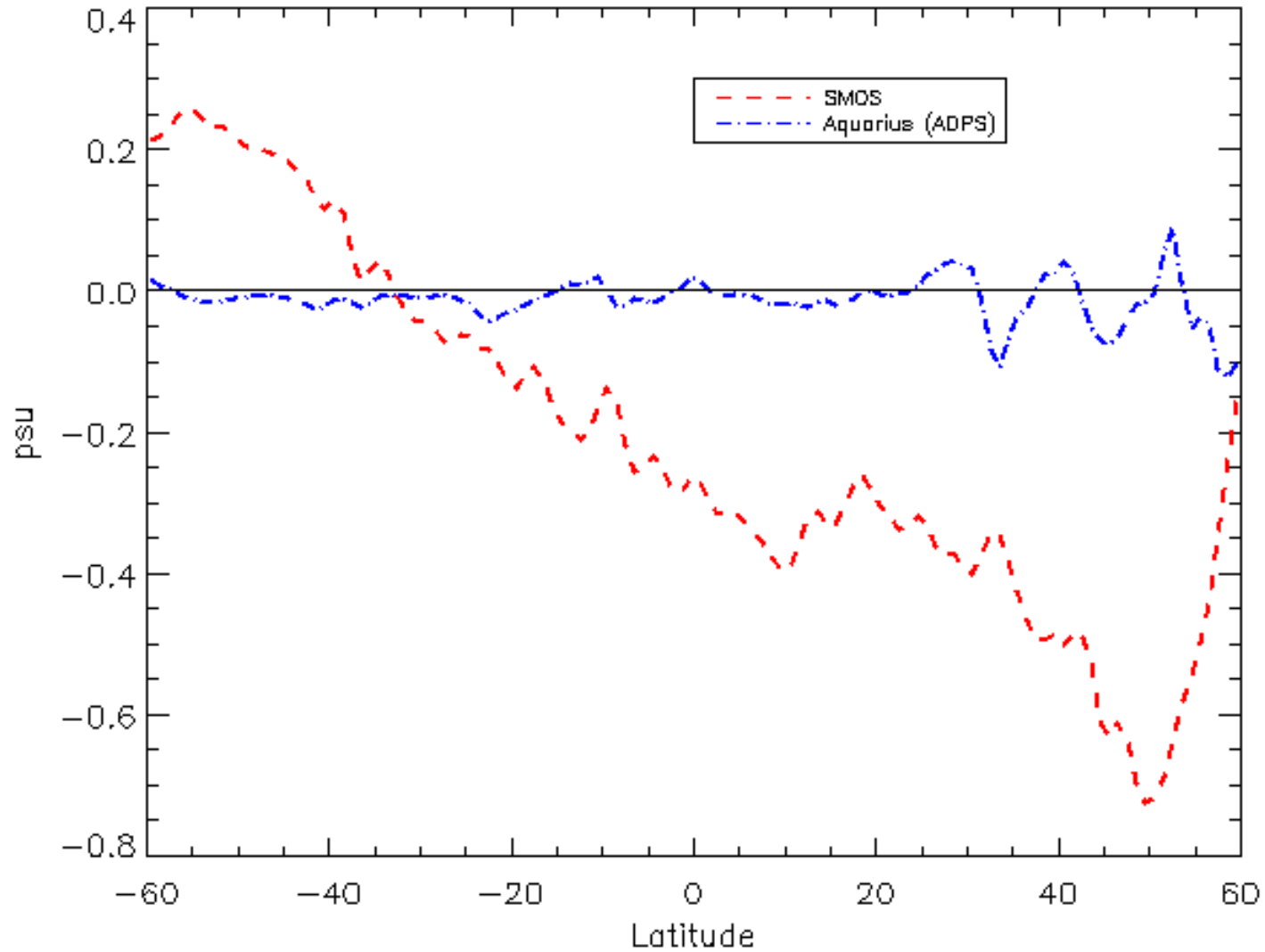


## SMOS

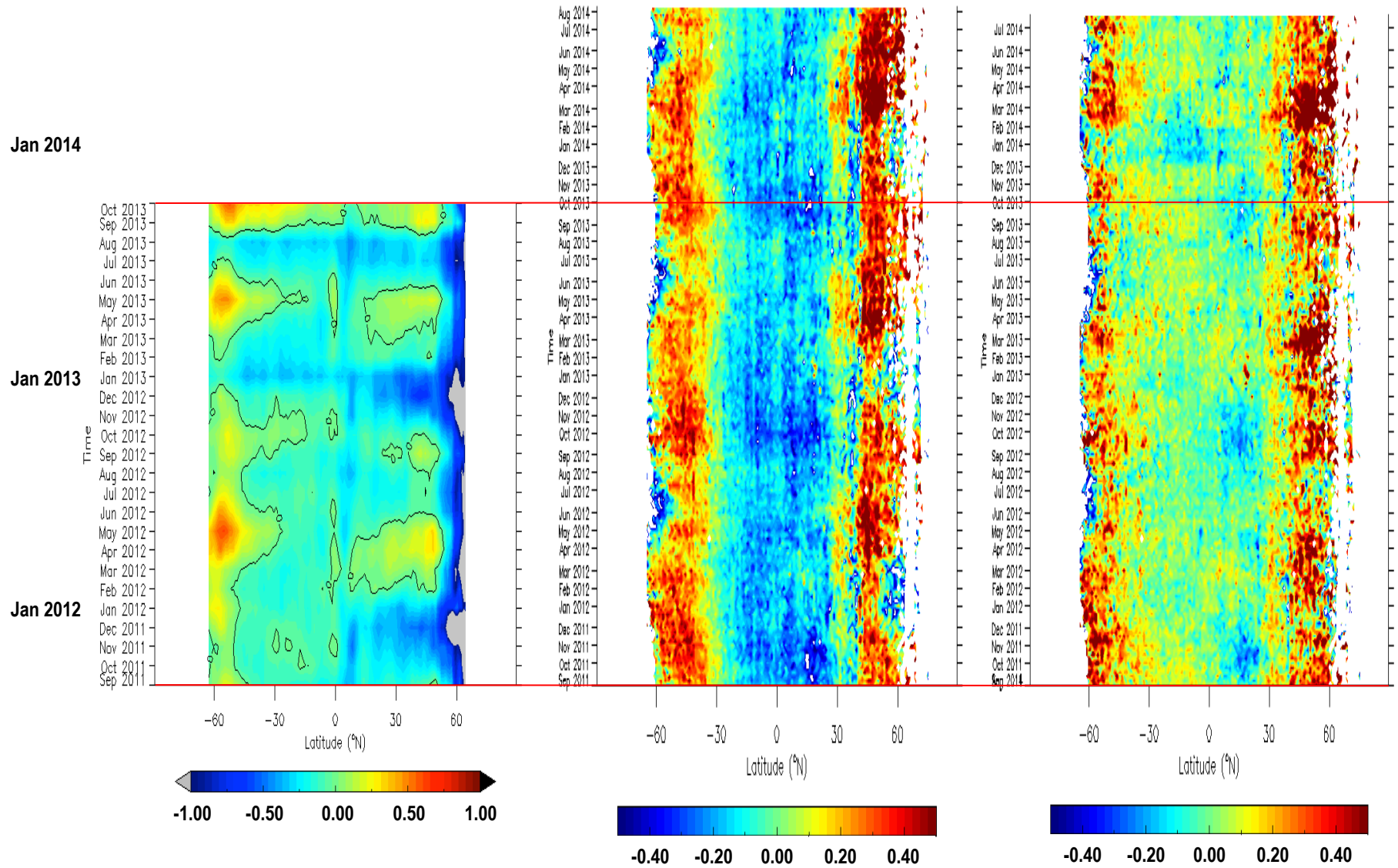


SSS Difference (pss)

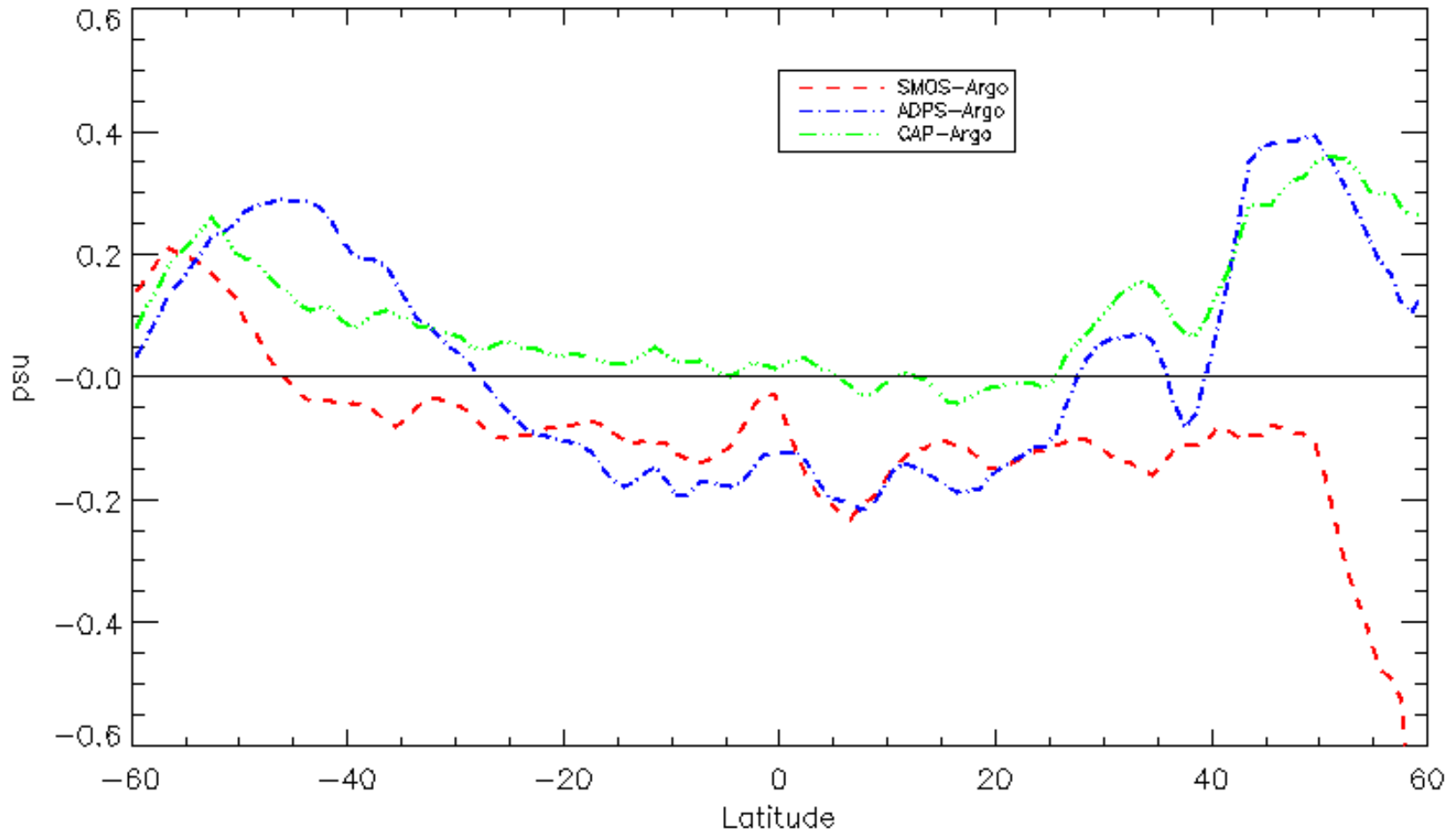
# Ascending-Descending Difference: Zonal Mean of Annual Mean



# Satellite-Argo Difference: Temporal



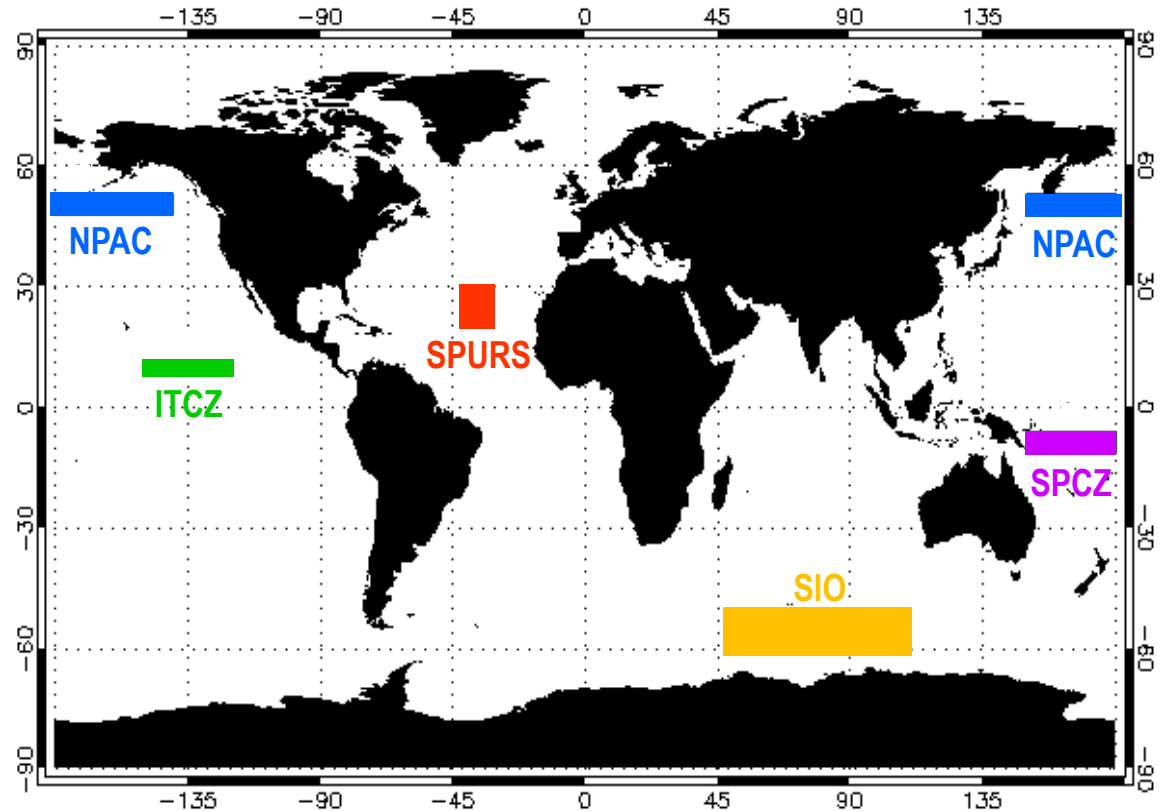
# Satellite - Argo Difference: Zonal Mean of Annual Mean



# Regional Analysis

## Regions:

- **InterTropical Convergence Zone (ITCZ)**
  - 8°N – 11°N, 120°W – 150°W
- **South Pacific Convergence Zone (SPCZ)**
  - 6°S – 11°S, 150°E – 180°
- **Salinity Processes in the Upper Ocean Regional Study (SPURS)**
  - 20°N – 30°N, 033°W – 042°W
- **North Pacific (NPAC)**
  - 48°N – 53°N, 150°E – 140°W
- **Southern Indian Ocean (SIO)**
  - 50S – 60S, 050E – 110E





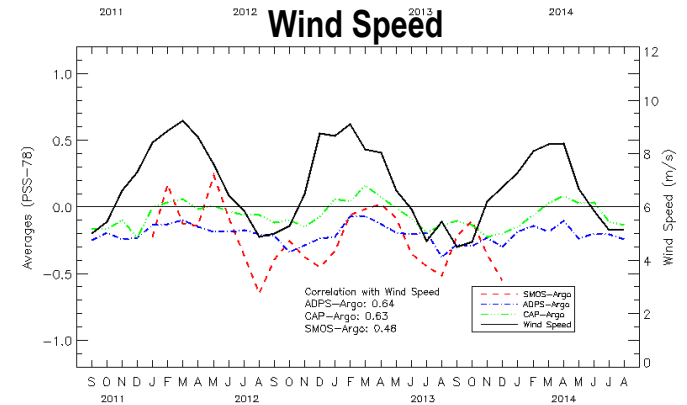
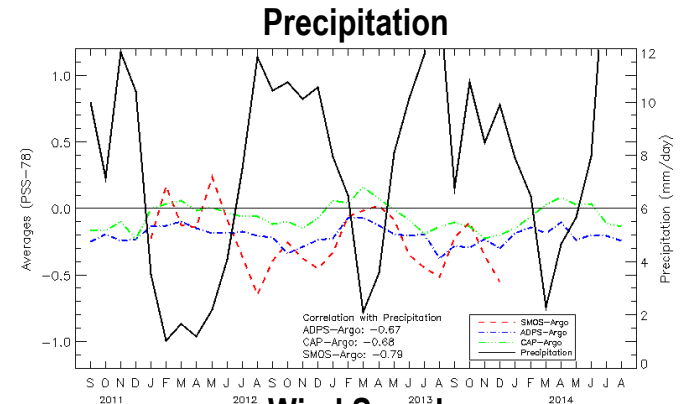
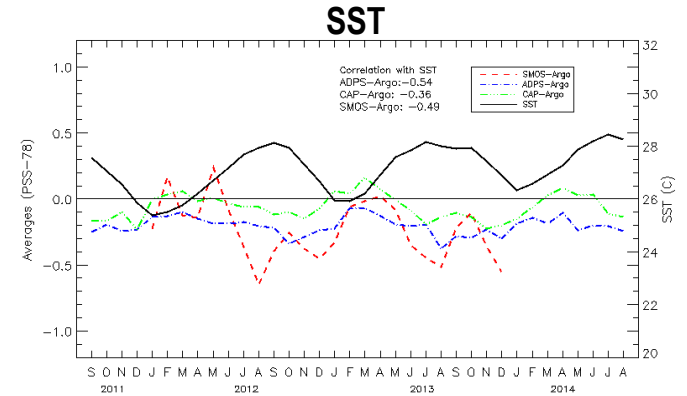
# ITCZ Regional Analysis: Satellite – Argo Difference

Correlation with SST  
 ADPS–Argo: -0.54  
 CAP–Argo: -0.36  
 SMOS–Argo: -0.49

**SMOS:** - - - -  
**ADPS:** - . - . -  
**CAP:** - . . - .

Correlation with Precipitation  
 ADPS–Argo: -0.67  
 CAP–Argo: -0.68  
 SMOS–Argo: -0.79

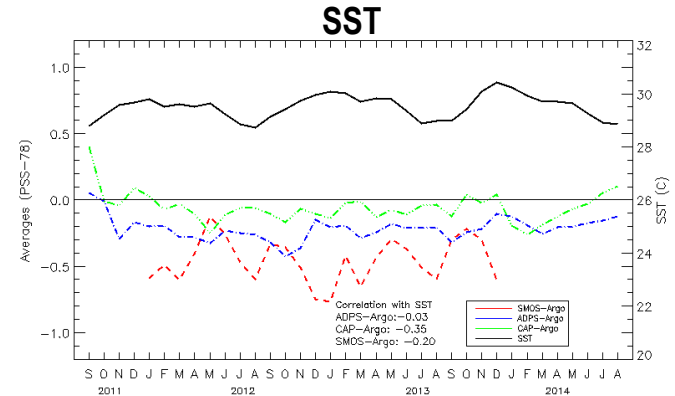
Correlation with Wind Speed  
 ADPS–Argo: 0.64  
 CAP–Argo: 0.63  
 SMOS–Argo: 0.48



For two-tailed probabilities, correlations exceeding  $\pm 0.5$ , are statistically significant at the 0.01 significance level and correlations less than  $\pm 0.5$ , but exceeding  $\pm 0.33$ , are statistically significant at the 0.1 significance level.

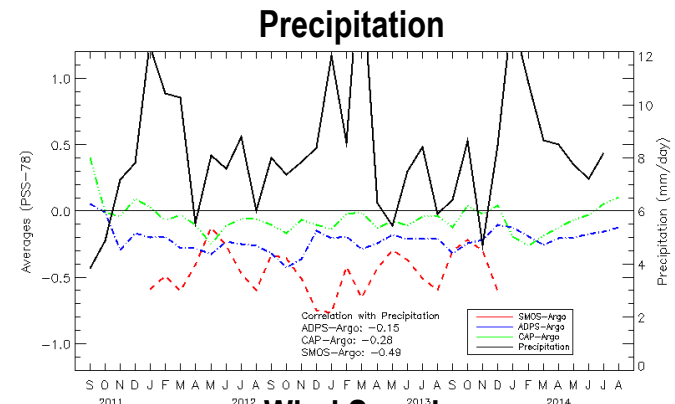
# SPCZ Regional Analysis : Satellite – Argo Difference

Correlation with SST  
 ADPS–Argo: -0.03  
 CAP–Argo: -0.35  
 SMOS–Argo: -0.20

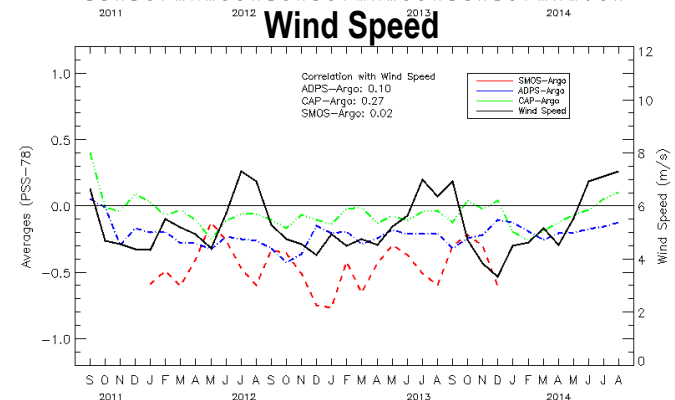


**SMOS:** - - - -  
**ADPS:** - . - . -  
**CAP:** - . - . -

Correlation with Precipitation  
 ADPS–Argo: -0.15  
 CAP–Argo: -0.28  
 SMOS–Argo: -0.49



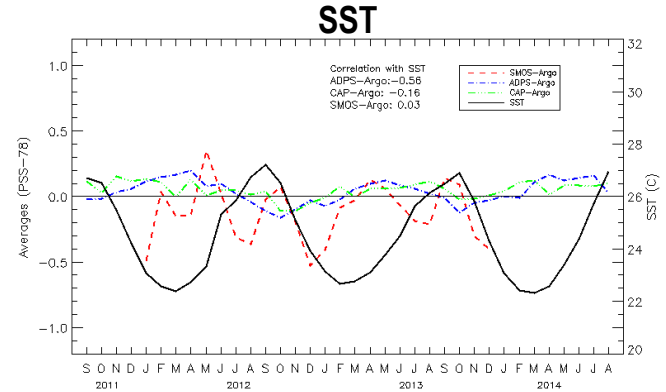
Correlation with Wind Speed  
 ADPS–Argo: 0.10  
 CAP–Argo: 0.27  
 SMOS–Argo: 0.02



For two-tailed probabilities, correlations exceeding  $\pm 0.5$ , are statistically significant at the 0.01 significance level and correlations less than  $\pm 0.5$ , but exceeding  $\pm 0.33$ , are statistically significant at the 0.1 significance level.

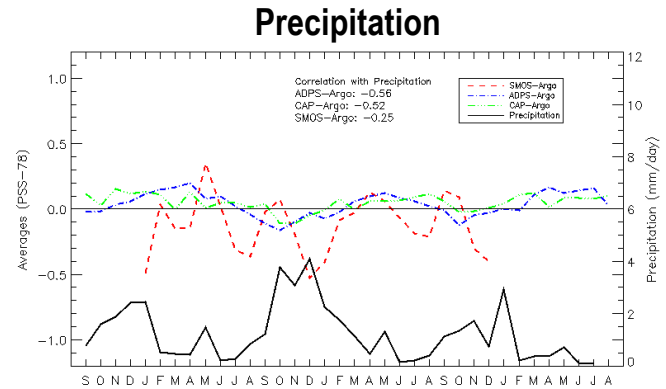
# SPURS Regional Analysis : Satellite – Argo Difference

Correlation with SST  
 ADPS–Argo: -0.56  
 CAP–Argo: -0.16  
 SMOS–Argo: 0.03

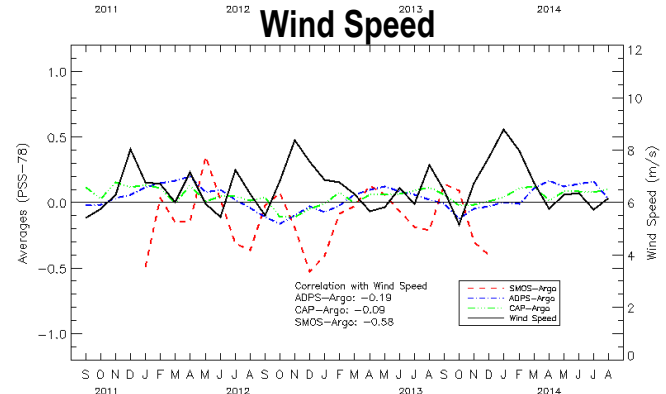


**SMOS:** - - - - -  
**ADPS:** - . - . -  
**CAP:** - . - . -

Correlation with Precipitation  
 ADPS–Argo: -0.56  
 CAP–Argo: -0.52  
 SMOS–Argo: -0.25



Correlation with Wind Speed  
 ADPS–Argo: -0.19  
 CAP–Argo: -0.09  
 SMOS–Argo: -0.58



For two-tailed probabilities, correlations exceeding  $\pm 0.5$ , are statistically significant at the 0.01 significance level and correlations less than  $\pm 0.5$ , but exceeding  $\pm 0.33$ , are statistically significant at the 0.1 significance level.

# NPAC Regional Analysis : Satellite – Argo Difference

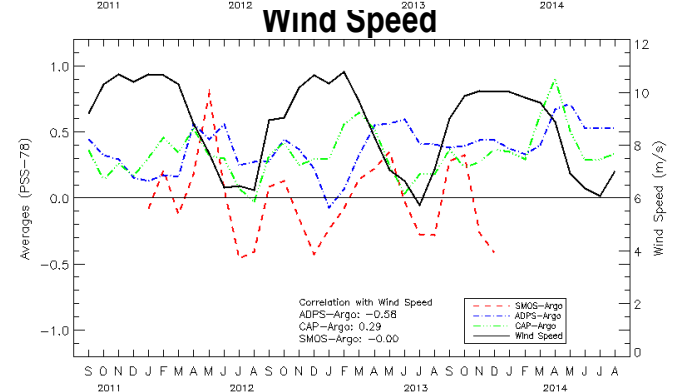
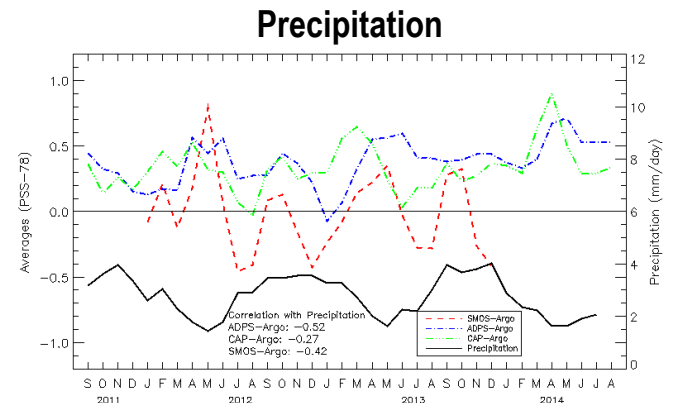
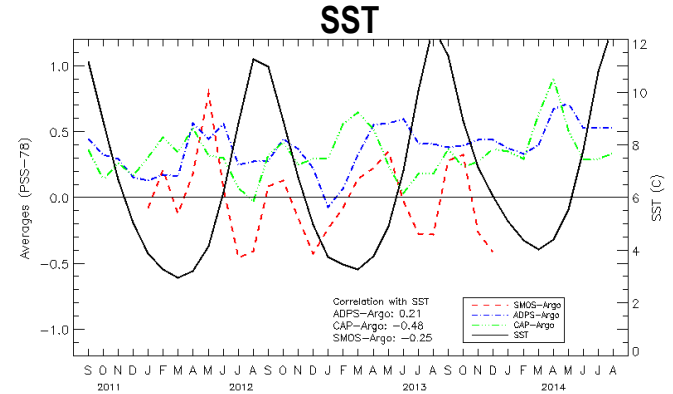
Correlation with SST  
 ADPS–Argo: 0.21  
 CAP–Argo: -0.48  
 SMOS–Argo: -0.25

**SMOS:** - - - -  
**ADPS:** - . - . -  
**CAP:** - . . - .

Correlation with Precipitation  
 ADPS–Argo: -0.52  
 CAP–Argo: -0.27  
 SMOS–Argo: -0.42

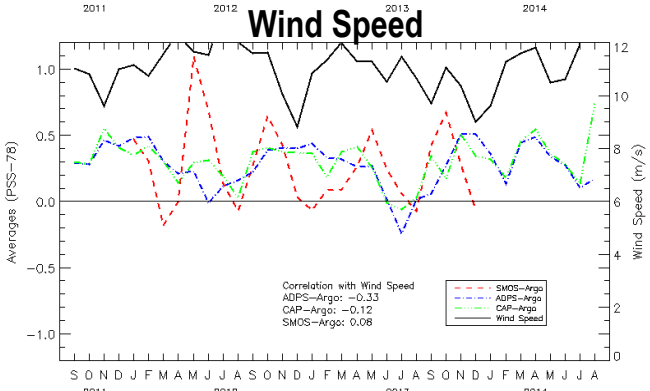
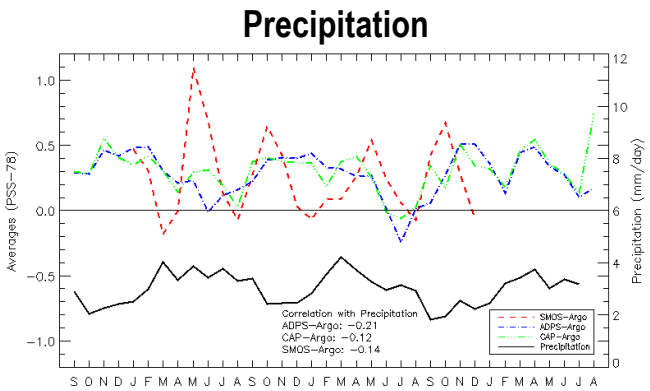
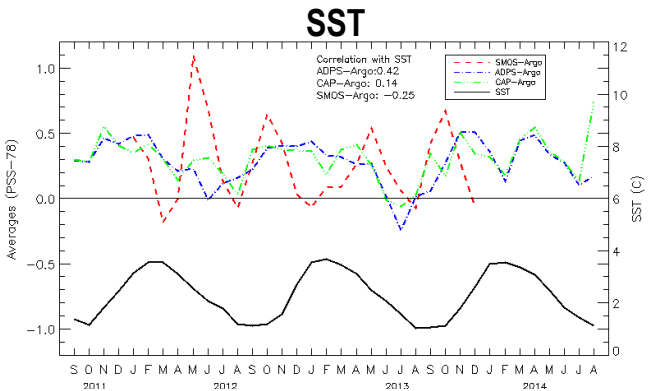
Correlation with Wind Speed  
 ADPS–Argo: -0.58  
 CAP–Argo: 0.29  
 SMOS–Argo: -0.00

For two-tailed probabilities, correlations exceeding  $\pm 0.5$ , are statistically significant at the 0.01 significance level and correlations less than  $\pm 0.5$ , but exceeding  $\pm 0.33$ , are statistically significant at the 0.1 significance level.



# SIO Regional Analysis : Satellite – Argo Difference

Correlation with SST  
 ADPS–Argo: 0.42  
 CAP–Argo: 0.14  
 SMOS–Argo: -0.25



**SMOS:** - - - - -  
**ADPS:** - . - . - .  
**CAP:** - . - . - .

Correlation with Precipitation  
 ADPS–Argo: -0.21  
 CAP–Argo: -0.12  
 SMOS–Argo: -0.14

Correlation with Wind Speed  
 ADPS–Argo: -0.33  
 CAP–Argo: -0.12  
 SMOS–Argo: 0.08

For two-tailed probabilities, correlations exceeding  $\pm 0.5$ , are statistically significant at the 0.01 significance level and correlations less than  $\pm 0.5$ , but exceeding  $\pm 0.33$ , are statistically significant at the 0.1 significance level.

# Summary

- **Ascending - Descending**

- South of about  $45^{\circ}\text{S}$ , a spatial pattern of alternating positive/negative ascending-descending node differences exists, regularly spaced and centered between the multiples of  $45^{\circ}$  of longitude
- Notable temporal variability for the region south of  $30^{\circ}$ .
  - The synchronization of the Aquarius variability with the solstices would seem to indicate that reflected galactic noise is the cause
  - Aquarius and SMOS have significantly differently temporal variability, bringing into question that reflected galactic noise is the underlying cause
- Zonally, SMOS has a distinct negative trend for  $60^{\circ}\text{S}$ - $50^{\circ}\text{N}$

- **Satellite vs Argo floats**

- In the Southern Hemisphere, SMOS data seasonality is approximately the inverse of Aquarius data seasonality
- SMOS data exhibits more seasonality in the Northern Hemisphere than Aquarius data
- SMOS data bias in the Northern Hemisphere is notably different from Aquarius data bias

- **Regional analysis**

- SMOS and Aquarius (ADPS & CAP) have notably different correlations with SST, precipitation, and wind speed, depending on the particular region.